Adaptive Shape Parameterization for Aerodynamic Design

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Abstract

We present an approach to aerodynamic optimization of discrete geometries in which the shape parameterization is progressively and automatically refined. The method alternates between optimization in an existing search space and discrete refinements of the parameterization to enable the discovery of superior designs. By automating refinement of control parameters and design variables the method achieves improved designs while reducing dependence on designer expertise and cost-to-solution. In addition to uniform shape control refinement, we also discuss adaptive refinement, where a new parameters are selected from a priority queue of the most promising candidate shape parameters. We apply the progressive refinement method to a series of two and 3-dimensional benchmark problems stemming from the 2015 AIAA Aerodynamic Design Optimization Discussion Group showing very good results for all examples. Adaptive shape control is demonstrated in two dimensions on a multipoint airfoil drag minimization problem with many constraints, and in three dimensions using a 3D shape-matching benchmark, in which our system automatically discovers the shape parameters necessary to match a target wing.